Anomaly Detection to Improve Airspace Safety and Efficiency, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)
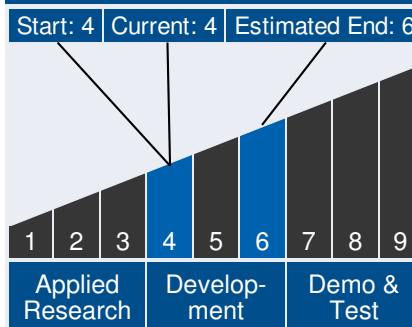
ABSTRACT

As the air transportation system becomes more autonomous in the coming years, there will be an increasing need for monitoring capabilities that operate in the background to identify anomalous behaviors indicating safety or efficiency deficiencies. Today, these behaviors are largely detected after an incident has occurred. In July 2013, an Asiana Boeing 777 flew too low approaching San Francisco International Airport (SFO), its tail hitting a seawall and crashing into the runway. Three people died and 180 were injured. This type of anomalous behavior (i.e. foreign pilots consistently flying too low into SFO on visual approach) could have been detected prior to the crash because the data was available, but no one was looking at it. Metron proposes to develop a semi-autonomous background monitoring system to apply this type of data mining and data discovery to flight track data in order to identify opportunities for improvements to safety and efficiency in airspace operations. In the Phase I effort, Metron demonstrated a proof-of-concept statistical approach that we call the Normalcy Score Broker (NSB), which uses historical flight data to develop models of normal behavior, and then applies statistical methods to combine multiple features into a single score for identifying outliers. Metron has used this same NSB technique to develop operational systems for customers in the land and maritime domains. In the Phase II, we propose to extend the techniques to process at scale, whether for real-time streaming data or for efficient analyses on forensic repositories. In addition to generating new features associated with clusters of flights interacting with each other, we propose to incorporate greater context (e.g., flight behavior in the presence of convective weather) and learning techniques to reduce false positives based on operator feedback on the relevance of the reported anomalies. We will test and evaluate our software on the NASA Cloud-based SMART-NAS Test Bed.

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Technology Maturity

Start: 4 | Current: 4 | Estimated End: 6

1	2	3	4	5	6	7	8	9
Applied Research			Development			Demo & Test		

Management Team

Program Executives:
- Joseph Grant
- Laguduva Kubendran
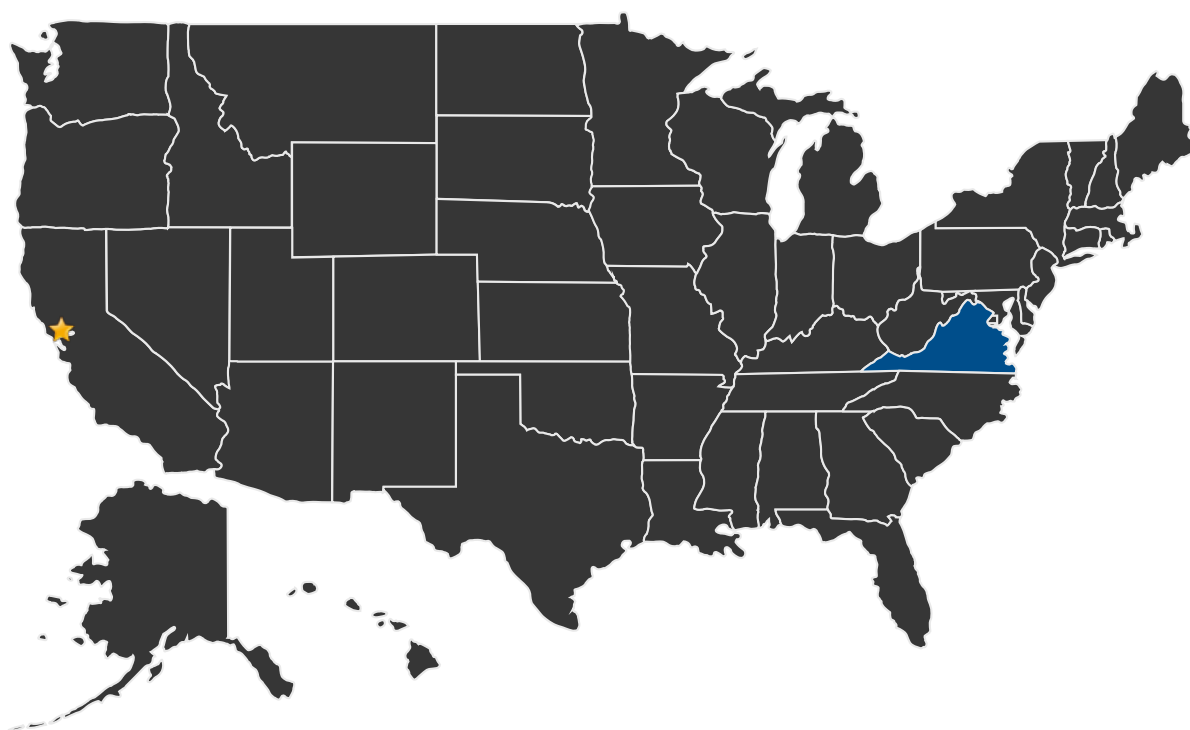
Program Manager:
- Carlos Torrez

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The long-term goal of this A3 Airspace Operations and Safety work is facilitating the development of autonomy in the future National Airspace System (NAS) through the modeling of how human behavior influences the details of flight path selection. The short-term goal is to improve the current NAS by identifying flights deemed ? anomalous? by a suite of indicators designed to assess flight efficiency and safety. The transition path for NASA priorities begins with the Performance Data Analysis and Reporting System (PDARS) flight repository, the source of the forensic data for this project. ATAC has been the primary developer / integrator of PDARS, and Metron is developing joint business opportunities with ATAC to complement their domain and visualization expertise with Metron?s analytics. Part of ATAC?s responsibilities on PDARS is to consolidate, to cleanse, and to otherwise add value to NAS data?the indicators that we propose to develop for this project are designed to aid that mission. During the execution of the Phase II, we will work with ATAC to transition our short-term technology to an FAA NextGen program (e.g., Collaborative Air Traffic Management Technologies (CATMT)), and leverage these in-roads to begin transitioning our deeper human-behavior modeling effort.

To the commercial space industry:

Potential Non-NASA Commercial Applications: For Non-NASA commercial applications, we plan to use the proposed work to extend our technology base of kinematic modeling and anomaly detection (which is focused on the land and sea domains) to include air operations. This will allow us to break into new areas within agencies such as the National Geospatial Intelligence Agency (NGA). NGA is already using our anomaly detection capabilities as part of a suite of tools that we have developed to support Activity Based Intelligence on land and maritime-based track data. In FY16, we will be moving some of these track

Management Team *(cont.)*

Principal Investigator:
- Gregory Godfrey

Technology Areas

Primary Technology Area:
Modeling, Simulation, Information Technology and Processing (TA 11)

analytics developed for NGA to a computing cloud environment, and the NASA Phase II development can provide a complementary set of techniques. Similarly for the Navy, much of our technology base for anomaly detection was developed as a kinematic component for Maritime Domain Awareness (MDA), where it is important to understand the behavior of commercial shipping. We would use the extension of this work into the air domain to develop a similar capability for the Air Force, providing capabilities for them to interact more safely and effectively within the context of civilian airspace.

U.S. WORK LOCATIONS AND KEY PARTNERS

■ U.S. States With Work   ⭐ **Lead Center:**
Ames Research Center

Other Organizations Performing Work:

- Metron, Inc (Reston, VA)

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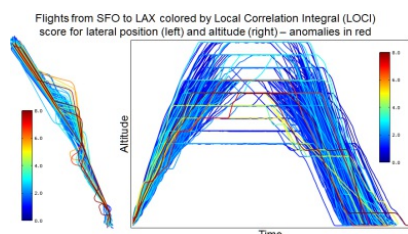SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23560)

IMAGE GALLERY

*Anomaly Detection to Improve Airspace
Safety and Efficiency, Phase II*

DETAILS FOR TECHNOLOGY 1

Technology Title

Anomaly Detection to Improve Airspace Safety and Efficiency, Phase II

Potential Applications

The long-term goal of this A3 Airspace Operations and Safety work is facilitating the development of autonomy in the future National Airspace System (NAS) through the modeling of how human behavior influences the details of flight path selection. The short-term goal is to improve the current NAS by identifying flights deemed ?anomalous? by a suite of indicators designed to assess flight efficiency and safety. The transition path for NASA priorities begins with the Performance Data Analysis and Reporting System (PDARS) flight repository, the source of the forensic data for this project. ATAC has been the primary developer / integrator of PDARS, and Metron is developing joint business opportunities with ATAC to complement their domain and visualization expertise with Metron?s analytics. Part of ATAC?s responsibilities on PDARS is to consolidate, to cleanse, and to otherwise add value to NAS data?the indicators that we propose to develop for this project are designed to aid that mission. During the execution of the Phase II, we will work with ATAC to transition our short-term technology to an FAA NextGen program (e.g., Collaborative Air Traffic Management Technologies (CATMT)), and leverage these in-roads to begin transitioning our deeper human-behavior modeling effort.